Letters to the Editor: Comment and Reply

Comment: Uncertainty in LCIA of Toxic Releases

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The article by ARNOLD TUKKER "Uncertainty in Life-Cycle Impact Assessment of Toxic Releases" (Int. J. LCA Vol. 3, No. 5, pp. 246 – 258, 1998) definitely presents a number of interesting thoughts and realities. However, a number of points require some clarification and expansion:

1) EUSES and similar models like CalTOX are often used for preliminary screening but are not limited to this role. For LCA, these models provide a prediction of the potential long-term contribution to risk associated with a continuous or time-averaged unit release of a chemical. The tool embodies "state-of-the-art" research efforts, which are continually under review. There are obviously variations and limitations in terms of applicability associated with the mechanisms represented, the type of chemicals that can be readily considered and the use of generic regional parameters. However, if needed and justified by additional information, generic models can be readily modified to be appropriate for specific cases.

2) It is suggested in Section 4.2 of the paper that the residence time or persistence of a toxic substance in the environment is not treated as a parameter of interest in its own right in current LCIA approaches. In a steady-state multimedia model like EUSES, the concentration of a chemical in any media is linearly proportional to its residence time in the modeled region. Therefore residence time is implicitly considered. However, atmospheric and aquatic advection rates used in the model can significantly influence this value, thus the concentration in any media and hence the calculated equivalency factor. Selection of the region boundaries and associated advection rates can therefore significantly influence the outcome of a relative comparison in an LCA.

The intrinsic persistence of a chemical, a measure of its duration in the environment and not just in a given region, is only addressed if a "unit world" or a global model approach is used. There is no removal from the system except by degradation (i.e. a closed system). Intrinsic persistence is now being used in national and international applications to identify a number of chemicals of potential concern (e.g. see the support materials for the draft US EPA Persistent Bioaccumulative Toxics (PBTs) Chemical List at www.epa.gov/wastemin/). As ARNOLD TUKKER points out, the intrinsic nature of a chemical is not typically addressed in LCA.

Regulatory actives can differ from LCA by identifying chemicals of potential concern, irrespective of the levels of release – the "precautionary principle". Unlike LCA, a highly persistent chemical of concern released in even very small quantities is considered to be a bigger problem than a large release of a low concern chemical. There are a number of reasons for this, including the potential ability of these chemical to effect impacts at remote locations with sensitive ecosystems. To mirror this regulatory approach, LCA would need to adopt an ordinal classification step to distinguish low from high concern chemicals prior to the use of current quantitative characterization practices.

3) The common use of deterministic values (one set of values) in LCA is a concern, although this may be intentional in TUKKER's paper. Environmental parameters, particularly degradation rates, are extremely variable. It is often not possible to state that a given value is incorrect, particularly when considering a variety of climatic zones, seasonal variations, etc. The three risk sets based on different data of ARNOLD TUKKER may all therefore be realistic values. What is unknown is the likelihood of each prediction. For example, which is nearest the median, the 5th percentile the 95th percentile, etc.

LCA needs to embrace the use of probabilistic approaches like those presented in CalTOX and, hopefully, in future releases of EUSES. Sensitivity analysis should be used to identify the important parameters prior to specification of the associated ranges with greater precision. The lack of sensitivity analysis has, for example, often led to misleading conclusions related to the need of degradation data for all media and therefore limited use of multimedia models. In reality, many toxic equivalency potentials can be derived using multimedia models given only an aquatic half-life. The time to determine this information and focus resources is trivial compared to the time required to collect LCI data.

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